

A REVISION OF THE *FLAVIDUS* GROUP OF THE
GENUS *CHRYSOPS* MEIGEN (DIPTERA: TABANIDAE)

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Abstract.—A taxonomic revision of the *Chrysops flavidus* species group is provided with a key to species, descriptions, distribution maps, and illustrations of wings and antennae for each of the nine species currently recognized in this group. The relationships and identification of these nine species are based on analysis of morphological similarity involving 13 critical characters. A total of 4,843 specimens from 14 institutions were examined during this study. Two new species in the *Chrysops flavidus* group are described, *Chrysops sandyi* and *Chrysops tumidicornis*, both previously misidentified as *Chrysops atlanticus*. The male of *Chrysops dixianus* is described for the first time.

Key Words: Diptera, Tabanidae, *Chrysops flavidus* group, key to species

The genus *Chrysops* Meigen is currently represented by 87 described species in the Nearctic Region north of Mexico (Burger 1995), and 291 world wide. This genus was last revised in North America by Philip (1955). Philip's revision included a key to 95 species and 14 subspecies, with corresponding notes on these taxa, and descriptions of 4 new species and 5 new subspecies (but it also treated species from Central America and the Caribbean).

Although no one has divided all of the Nearctic *Chrysops* into definitive species groups, some species groups have been recognized by tabanid taxonomists. The three commonly used are the *Chrysops callidus* group, the *C. carbonarius* group, and the *C. flavidus* group (Pechuman 1949). The *C. flavidus* group is particularly difficult because of the large amount of intraspecific variation within the included taxa. Although three species have been described in this group during the past 45 years, no one has studied the group as a whole.

The *Chrysops flavidus* group currently

includes 7 previously described species and two new species: *Chrysops atlanticus* Pechuman, *C. brunneus* Hine, *C. celatus* Pechuman, *C. dixianus* Pechuman, *C. flavidus* Wiedemann, *C. pudicus* Osten Sacken, and *C. reicherti* Fairchild, *C. sandyi*, n.sp., and *C. tumidicornis*, n. sp. I will redescribe, clarify relationships and summarize the biology and geographic distribution of this group. Immature stages and habitat are discussed under the description of each species.

MATERIALS AND METHODS

I examined 4,843 specimens, (4,684 females and 159 males), from the collections listed below. The acronyms are those of Arnett et al. (1993), except for the University of New Hampshire Collection (UNHC).

AMNH: Department of Entomology, American Museum of Natural History, New York, NY; David A. Grimaldi.

BMNH: Department of Entomology, The

- Natural History Museum, London, U. K.; John E. Chainey.
- CASC: Department of Entomology, California Academy of Sciences, San Francisco; Paul H. Arnaud, Jr.
- CNCI: Canadian National Collection, Centre for Land and Biological Resources Research, Agriculture Canada, Ottawa, Ontario; J. M. Cumming.
- CUCC: Department of Entomology, Clemson University, Clemson, SC; Michael A. Floyd.
- CUIC: Department of Entomology, Cornell University, Ithaca, NY; E. Richard Hoebeke.
- FMNH: Division of Insects, Field Museum of Natural History, Chicago, IL; Alfred F. Newton, Jr.
- FSCA: Florida State Collection of Arthropods, Division of Plant Industry, Gainesville; G. B. Fairchild.
- INHS: Illinois Natural History Survey Insect Collection, Champaign; Kathleen R. Methven.
- OSUC: Ohio State University, Collection of Insects and Spiders, Columbus; Andrey Sharkov.
- TAMU: Department of Entomology Insect Collection, Texas A. & M. University, College Station; Edward G. Riley.
- UGCA: Entomology Collection, University of Georgia, Athens; Cecil L. Smith.
- UNHC: Entomological Museum, Department of Zoology, University of New Hampshire, Durham; Donald S. Chandler.
- USNM: National Museum of Natural History, Smithsonian Institution, Washington, DC; R. V. Peterson.
- MRSN: Museo Regionale Scienze Naturali, Via Gioletti 36, Torino 10128, Italy.
- MZLU: Museum of Zoology, Lund University, Helgonavägen 3, S-223 62 Lund, Sweden.
- ZMHB: Museum für Naturkunde der Humboldt Universität zu Berlin, Bereich Zoologischer Museum, Invalidenstrasse 43, 1040 Berlin, Germany.

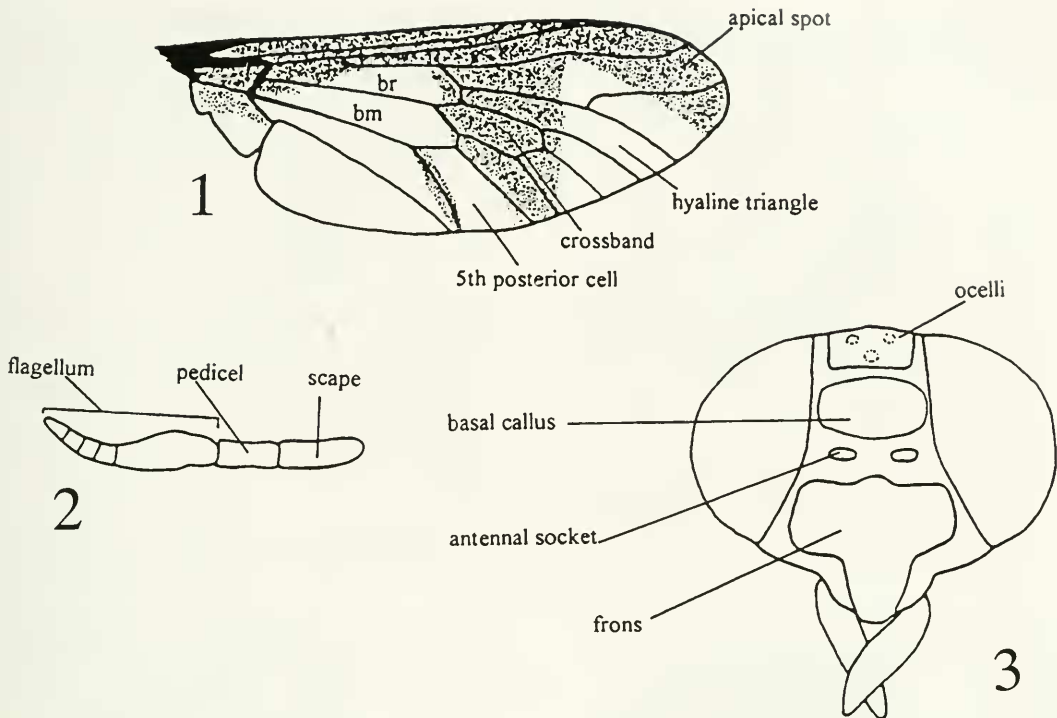
The *Chrysops flavidus* group has few distinctive structural characters, and the species can be difficult to identify. Color patterns are important in identification but must be used with caution because of variation. The characters described below are the most useful in separating the species. The morphological terminology used in this paper follows that used by Teskey (1990). Principal characteristics used are: body length, in millimeters, from the base of the antennae to the apex of the abdomen; the size and shape of the scape and pedicel as well as the length ratio and color of the scape, pedicel, and flagellum; shape of the frontal callus; color of the mesoscutum; wing pattern, particularly the width of the apical spot, the location of the outer margin of the crossband, and the infuscation of the 5th posterior cell; color of the hind femur; and abdominal color pattern.

For illustrations, I chose a specimen that most closely resembled the description of the holotype. One wing from each specimen was removed, placed between two 2 × 2 glass slides and scanned into a Dell 486p/25 computer using MICROTEK ScanMaker 35t. The scanned picture was printed and used as a template for the final drawing. The antennal drawings were produced with a camera lucida.

The locality data from all specimens examined were entered into a database using Wordtech Systems, dBXL® (a dBASE III Plus® compatible format). The information collected was placed into 9 "fields": species, country, state, county, town, collector,

The following insect collections are also cited in this paper:

MNHN: National Collection of Insects, Muséum National d'Histoire Naturelle, 45, Rue Buffon, Paris 75005 France.



Figs. 1-3. 1, Wing of *Chrysops* species. 2, Antenna of *Chrysops* species. 3, Anterior view of head of *Chrysops* species.

museum, count (number of specimens with identical data), and sex (male or female). Locality data for specimens I did not examine were taken from the distribution records of L. L. Pechuman, now stored in the Zoology Department at the University of New Hampshire. Distribution maps were then produced for each species from the above database and from the records of L. L. Pechuman.

DIAGNOSIS OF THE
CHRYSOPS FLAVIDUS GROUP

Frontoclypeus glossy yellow with no mid-facial stripe; frontal callus yellow to light brown, occasionally with brown upper margin; frons yellow pollinose; mesoscutum with 3 longitudinal stripes, darker than ground color; proepimeron and proepisternal callosity yellow tomentose with long yellow hair; wing pattern with broad apical spot entering 2nd submarginal cell, crossband reaching hind margin of wing, hyaline

triangle not crossing vein R_{2+3} , cell br at least $\frac{1}{3}$ infuscated basally; abdominal tergites 2-4 patterned with median inverted "V" set over pale median triangle.

KEY TO SPECIES OF THE
CHRYSOPS FLAVIDUS GROUP

1. Scape and pedicel distinctly swollen, together longer than flagellum (Fig. 14). Frontal callus twice as wide as high, with no black markings. Abdomen with inconspicuous median triangles. Wing pattern with extensive apical spot, reaching crossband posteriorly and enclosing hyaline crescent (Fig. 23) *brunneus* Hine
- Scape and pedicel less swollen, combined length equal to or shorter than flagellum. Without remaining combination of characters 2
2. Usual hyaline areas of wing slightly smoky to very smoky, outer margin of crossband angled from vein R_4 to middle of vein M_4 (Fig. 22). Scape and pedicel moderately swollen, combined length equal to or rarely longer than flagellum (Fig. 13). Mesoscutum green-gray iridescent with black longitudinal stripes *atlanticus* Pechuman
- Without above combination of characters 3

- 3. Mesoscutum greenish gray or steel gray in ground color, longitudinal stripes black. Outer margin of crossband sinuous 4
- Mesoscutum yellow in ground color, longitudinal stripes brown. Outer margin of crossband, straight, concave, or sinuous 6
- 4. Antenna not swollen, flagellum at least $\frac{1}{2}$ longer than scape and pedicel combined (Fig. 15). Frontal callus spade shaped, width and height subequal. Without dark spot under scutellum *celatus* Pechuman
- Scape and pedicel slightly swollen to swollen, combined length subequal to flagellum. Frontal callus, width and height not equal. Abdomen with dark spot under scutellum, often extending to lateral edges of tergite 1 5
- 5. Hyaline triangle not reaching vein R_{2+3} , cells br and bm $\frac{3}{4}$ and $\frac{1}{2}$ infuscated basally (Fig. 30). Scape and pedicel swollen, pedicel barrel shaped (Fig. 21). Frontal callus light brown. Mesoscutum gray green with black stripes *tumidicornis*, n. sp.
- Hyaline triangle reaches vein R_{2+3} , apical spot narrowly enters 2nd submarginal cell, cells br and bm $\frac{1}{2}$ and $\frac{1}{6}$ infuscated basally (Fig. 27). Scape and pedicel slightly swollen (Fig. 18). Frontal callus reddish brown with black upper margin. Mesoscutum steel gray with black stripes *pudicus* Osten Sacken
- 6. Abdominal tergites 1-2 light yellow to straw color, dark inverted "V" on tergite 2 compressed, not reaching beyond the middle of tergite 2. Flagellum 1.3 to 1.5 times longer than scape and pedicel combined 7
- Abdominal tergites 1-2 yellow, orange or light brown, inverted "V" pattern not compressed, extending beyond the middle of tergite 2 toward anterior margin. Flagellum equal to or up to 1.2 times longer than scape and pedicel combined 8
- 7. Fifth posterior cell infuscated, outer margin of crossband sinuous, cells br and bm $\frac{1}{2}$ and $\frac{1}{4}$ infuscated basally (Fig. 28). Hind femur reddish-brown. Tergites 1-2 straw-colored, median anterior portion of tergite 2 with a greenish cast. Length 8-9.5 mm *reicherti* Fairchild
- Fifth posterior cell hyaline, vein Cu_2 infuscated at border, outer margin of crossband straight or convex, cells br and bm $\frac{1}{2}$ and $\frac{1}{5}$ infuscated basally (Fig. 25). Hind femur dark brown. Tergites 1-2 yellow without a greenish cast. Length 6-8.5 mm *dixianus* Pechuman
- 8. Hind femur yellow. Mesoscutum yellow with brown stripes. Outer margin of crossband straight or concave, cells br and bm $\frac{1}{2}$ and $\frac{1}{2}$ infuscated basally (Fig. 26). Scape and pedicel slightly swollen (Fig. 17). Length 8-10 mm *flavidus* Wiedemann

- Hind femur dark brown basally. Mesoscutum yellow green with brown stripes. Outer margin of crossband straight, hyaline triangle slightly tinted, cells br and bm $\frac{1}{2}$ - $\frac{1}{2}$ and $\frac{1}{5}$ infuscated basally (Fig. 29). Scape and pedicel not swollen (Fig. 20). Length 5.7-7.5 mm *sandyi*, n. sp.

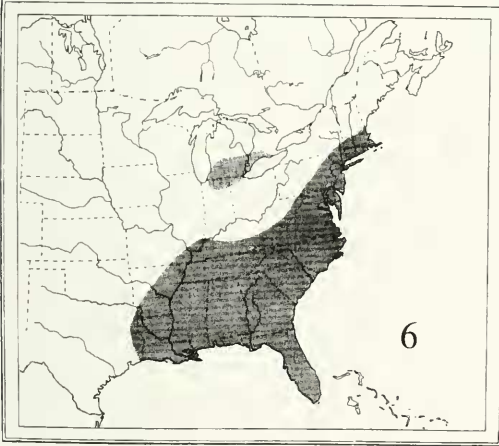
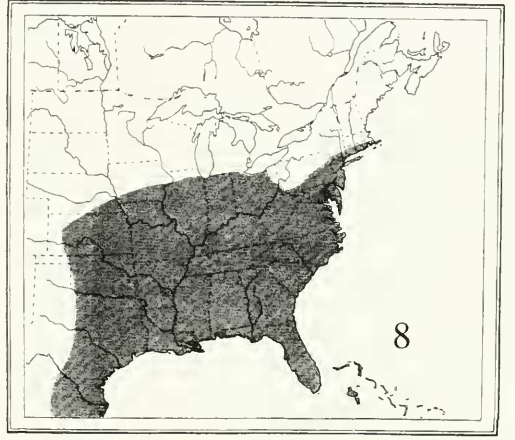
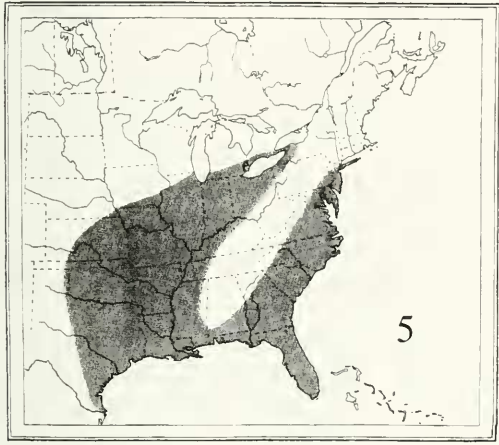
Chrysops atlanticus Pechuman
(Fig. 4, 13, 22)

Chrysops canifrons Walker 1848: 197-198. Holotype female: Florida (BMNH). Senior synonym of *atlanticus*, suppressed by the International Commission on Zoological Nomenclature, Opinion No. 1711, 1993.

Chrysops atlanticus Pechuman 1949: 79-82. Holotype female: Rehoboth Beach, Delaware (CUIC); Jamback and Wall 1959: 23-24, description of egg, larva and pupa; Teskey 1969: 29-30, description of larva; Goodwin 1972: 104, description of pupa.

Diagnosis.—Length 6.5-9.2 mm. Scape and pedicel moderately swollen, flagellum equal to length of scape and pedicel combined. Mesoscutum grayish green in ground color. Wing pattern with smoky tinge, hyaline areas not clearly defined, hyaline triangle not extending beyond lower half of 1st submarginal cell.

Female.—Light to dark brown, length 8.5-9.2 mm. Scape and pedicel moderately swollen, light brown, basal flagellomere light brown, apical flagellomeres black, length of flagellum subequal to combined length of scape and pedicel, antennal ratio 15:10:25. Frontoclypeus glossy yellow, eye margins bearing yellow tomentum that extends medially beneath tentorial pits to frontoclypeal suture. Maxillary palp brown with sparse black hairs. Frons yellow and gray tomentose with yellow hairs at vertex, width 1.13 times height. Frontal callus oblong, bulbous, light brown, width 1.54 times height. Vertex with glossy black integument surrounding shining brown ocelli. Mesoscutum grey green iridescent with three black longitudinal stripes, sublaterals



Figs. 4-9. Distributions. 4, *Chrysops atlanticus*. 5, *C. brunneus*. 6, *C. celatus*. 7, *C. dixianus*. 8, *C. flavidus*. 9, *C. pudicus*.

wider than median one, scutellum predominantly brown, lighter medianly. Legs predominantly yellow, hind coxa and fore tarsi brown, fore tibia with black hair, mid and hind tibia with mixed yellow and black hair. Wing pattern with usual hyaline areas smoky, apical spot broad, fading into 2nd submarginal cell, crossband brown with irregular outer margin, crossing 1st posterior cell at its center, a perpendicular line drawn from vein R_1 to hind margin of wing not forming line parallel to outer margin of crossband, hyaline triangle not extending beyond posterior $\frac{1}{2}$ of 1st submarginal cell, discal cell, 4th and 5th posterior cells infuscated, 5th posterior cell paler in center, cells br and bm $\frac{3}{4}$ and $\frac{1}{3}$ basally infuscated. Halter brown stalk yellow-brown knob. First abdominal tergite dark yellow, black haired medianly, tergites 2–5 with submedian oblique dark spots, gray posterior margin extending medianly into pale orange, equilateral triangle, dark spots on tergite 2 outline triangle and join anteriorly forming inverted "V" pattern, tergites 3–5 with submedian dark spots slightly separated anteriorly. Sternites 1–2 yellow, sternite 3 mottled yellow and brown, sternites 4–7 dark brown.

Male.—Similar to female except for usual sexual differences and following characteristics. Length 6.5–8 mm. Scape and pedicel slightly more enlarged with black hair that is longer and finer than on female. Mesoscutum sparsely covered with long yellow hair. Cell br entirely infuscated except for a subapical hyaline spot. Abdomen with yellow and black hair scattered over pattern.

Material examined.—934 ♀ and 18 ♂ examined from the following collections: CASC, CNCI, CUCC, CUIC, FMNH, FSCA, INHS, OSUC, TAMU, UGCA, UNHC, USNM.

Distribution.—Atlantic coast of North America from Maine to Florida. I have examined specimens from AL, DE, FL, GA, LA, MA, ME, MD, MS, NC, NH, NJ, NY,

SC, TN, and VA. There are also published records for CT and RI.

Biology.—The larvae have been found in salt marsh and brackish pools. Based on their narrow distribution along the coast, they are probably restricted to this saline environment. Flight times for *C. atlanticus* are between April and September in Louisiana (Tidwell 1973), June to September in Virginia (Pechuman 1973), and late May to mid October in New York (Pechuman 1981). The adults are abundant during June and July throughout their range and are economically important due to their aggressive biting behavior. Thirty *C. atlanticus* bites were counted on 1 human in 90 seconds in a cultivated field near Cedarville, New Jersey, (Hansens, 1980). Anderson (1971) described *C. atlanticus* as being autogenous, depositing the first egg mass before seeking a blood meal. Subsequent work by Magnarelli and Anderson (1976) concluded that populations of *C. atlanticus* can be maintained by the first oviposition, making them difficult to control.

Chrysops atlanticus is not known to transmit any disease agent in nature; however, in the laboratory, tests have demonstrated it to be an effective experimental vector of the African filarial worm *Loa loa* (Orihel and Lowrie 1975).

Discussion.—*Chrysops atlanticus* is most similar to *C. sandyi*, *C. tumidicornis*, and to *C. brunneus*, based on the smoky wing pattern, association with a saline environment, and swollen antennae. *Chrysops atlanticus* differs from *C. brunneus* in its narrower scape and pedicel (Fig. 22) that when combined are equal in length to the flagellum, moderately inflated frontal callosity, grayish-green mesoscutum, and wing pattern without clearly defined hyaline areas. *Chrysops atlanticus* differs from *C. sandyi* in its larger size, blackish longitudinal stripes on the mesoscutum, and crossband with irregular outer margin. *Chrysops atlanticus* differs from *C. tumidicornis* in its larger size, less swollen pedicel, smokier wing pattern, and lighter abdominal pattern

that does not have a dark spot on tergite 1 under the scutellum. There appears to be no overlap in the geographical distribution of *C. atlanticus* with either *C. sandyi* or *C. tumidicornis*.

Color variation in *C. atlanticus* is common throughout its range, making it particularly difficult to define. The abdominal pattern can vary from tergites 2–6 having a pale inverted "V" formed by hair, to a dark, well defined, integumental inverted "V" pattern that includes $\frac{2}{3}$ or more of the tergite. In all these cases, the characteristic wing pattern described above and the inflated scape and pedicel will define *C. atlanticus*.

Chrysops brunneus Hine

(Figs. 5, 14, 23)

Chrysops brunneus Hine 1903: 34. Syn-types female and male: Sandusky, Ohio, ♀ ♂ (OSUC), 1 ♀ (BMNH); Goodwin 1976: 343, description of larva and pupa.

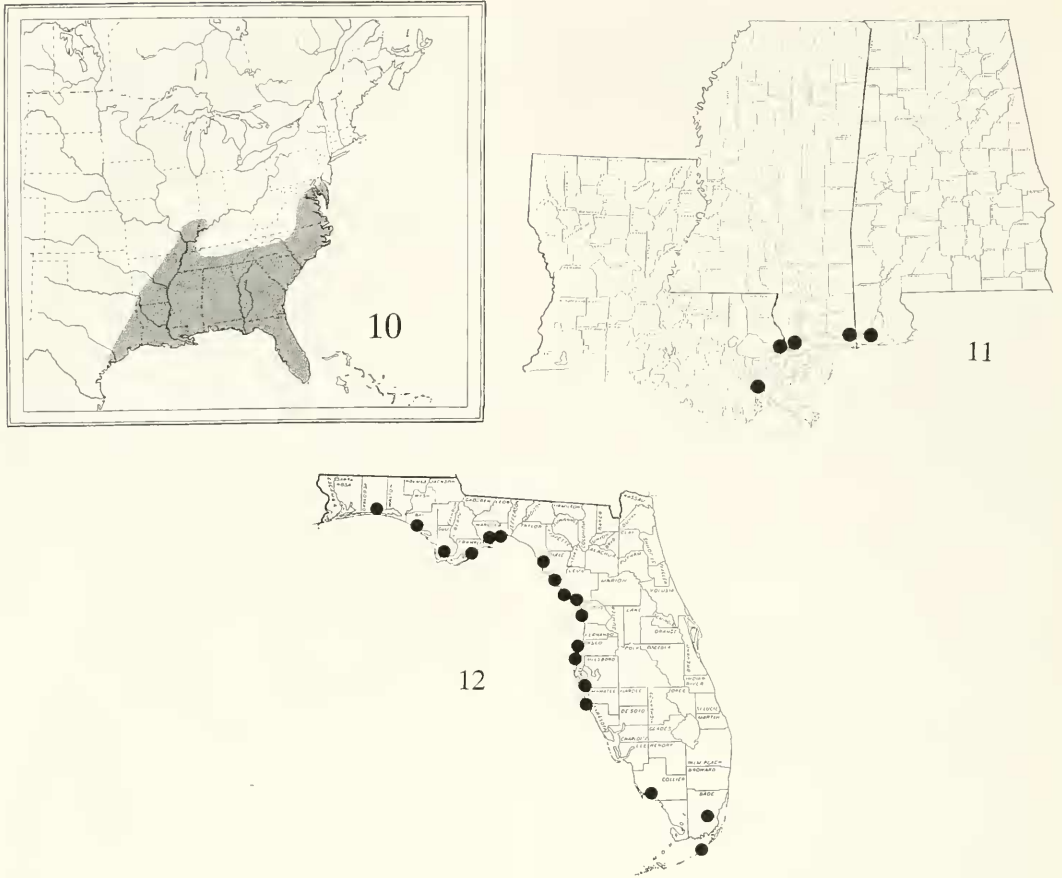
Diagnosis.—Robust species, length 8–10 mm. Antenna with scape and pedicel swollen, flagellum distinctly shorter than combined length of scape and pedicel. Frontal callus strongly inflated, width twice height. Wing with apical spot extensive, reaching around margin of wing to crossband and enclosing hyaline crescent. Cells br and bm $\frac{3}{4}$ and $\frac{1}{2}$ infuscated basally. Abdominal pattern indistinct.

Female.—Yellowish brown. Scape and pedicel distinctly swollen, scape twice as long as broad, light brown, black setose, basal flagellomere yellow basally, dark brown apically, apical flagellomeres black, flagellum distinctly shorter than scape and pedicel combined, antennal ratio 18:12:25. Frontoclypeus glossy yellow, eye margins bearing yellow tomentum that extends medianly beneath tentorial pits to frontoclypeal suture. Maxillary palp light brown with sparse black hairs. Frons yellow tomentose with scattered yellow hairs, convergent above, height 1.3 times width at base. Frontal callus elliptical, distinctly nar-

rowed laterally, strongly inflated, light brown, upper margin dark brown, width twice height. Vertex dark brown tomentose, except glossy around each ocellus, ocelli dark brown. Mesoscutum light brown tomentose and yellow pilose, except lateral margins pale yellow-gray tomentose, bearing 3 longitudinal stripes, median stripe very narrow, dark brown, sublateral stripes brown and broad. Scutellum dark brown basally, brown apically, yellow pilose. Pleuron yellow-gray tomentose. Fore coxa light brown tomentose, mid and hind coxa dark brown tomentose, femur, tibia and tarsus light brown, femur and tibia bearing yellow hairs, except apices of tibia bearing mixed yellow and black hairs, tarsus bearing mixed yellow and black hairs. Wing pattern distinct, apical spot broad, extending around wing margin to crossband, leaving narrow hyaline band along outer margin of crossband that does not reach vein R_{2+3} , outer margin of crossband straight or sinuous, 5th posterior cell infuscated, cells br and bm $\frac{3}{4}$ and $\frac{1}{2}$ their length respectively. Halter with dark brown stalk and light brown knob. Abdomen uniformly brown, lacking dark integumental markings, tergite 1 with black hair medianly, yellow hair laterally, tergites 2–4 predominantly black-haired, except for yellow hairs on posterior margin that expand medianly into indistinct yellow-haired triangles, tergites 5–7 with mixed black and yellow hairs forming no distinct pattern. Sternites 1–5 light brown, sternites 3–5 with progressively larger median and lateral brown integumental spots, 6–7 dark brown, all sternites with mixed black and yellow hairs.

Male.—Resembles female except for the usual sexual differences and the following characteristics. Length 8.2–10 mm, scape and pedicel slightly more inflated than in female, with longer, finer black hair, frontoclypeus with yellow tomentose triangle at vertex, cheeks yellow pollinose. Long yellow hairs scattered over mesoscutum, scutellum, and abdomen.

Material examined.—502 ♀ and 14 ♂



Figs. 10–12. Distributions. 10, *Chrysops reicherti*. 11, *C. sandyi*. 12, *C. tumidicornis*.

were examined from the following collections: AMNH, CASC, CNCI, CUCC, CUIC, FMNH, FSCA, INHS, OSUC, TAMU, UGCA, UNHC, USNM.

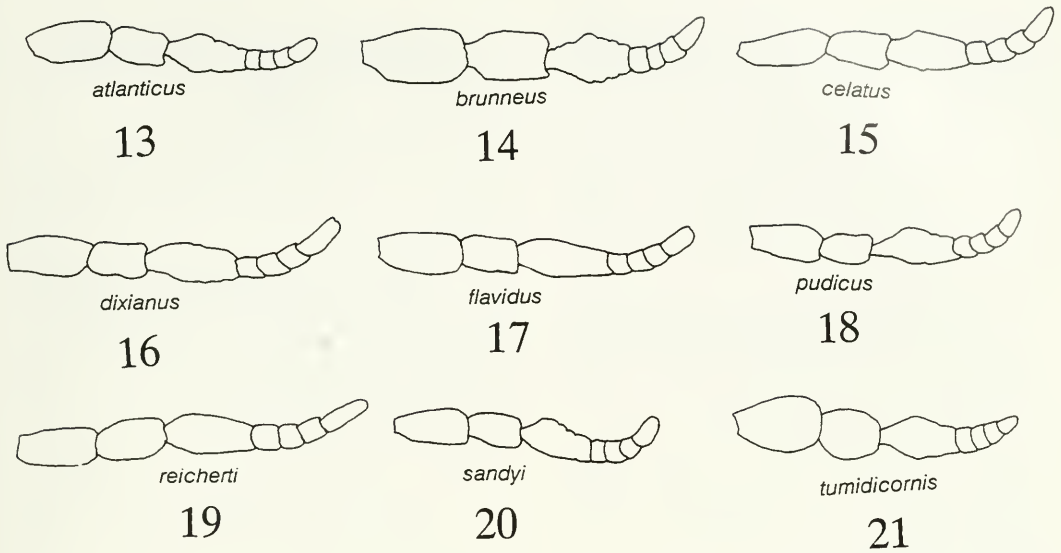
Distribution.—New York to Florida, west to Texas, and north to Michigan and southern Ontario. It is not found in the Appalachian Highlands and surrounding terrain. I have examined specimens from: AL, AR, DE, FL, GA, IL, IN, KS, KY, LA, MD, MI, MS, NJ, NY, OH, OK, PA, SC, TN, TX, and VA. It is also known from IA, MO, NC, and Ontario, Canada.

Biology.—*Chrysops brunneus* is associated with both fresh and salt water habitats. Goodwin (1976) reared a larva of this species collected from a salt marsh in McClellanville, SC. Adults are commonly

found in marshes near lakes such as Lake Michigan, Lake Erie and Lake Ontario.

Discussion.—*Chrysops brunneus* is very distinctive and can be separated from other species of the *C. flavidus* group by its strongly inflated scape and pedicel that combined are longer than the flagellum, and by its reduced hyaline triangle appearing as a crescent-shaped area between the cross-band and broad apical spot. The smoky wing pattern of *C. brunneus* and its presence in a saline environment are similar to that of *C. atlanticus*, but is easily separated by those characters noted above.

The only variation observed in this species was the abdominal pattern that has tergites 2–3 with small, median, black dashes on the integument in approximately 5% of



Figs. 13–21. Female antennae. 13, *Chrysops atlanticus*. 14, *C. brunneus*. 15, *C. celatus*. 16, *C. dixianus*. 17, *C. flavidus*. 18, *C. pudicus*. 19, *C. reicherti*. 20, *C. sandyi*. 21, *C. tumidicornis*.

the specimens examined. Ordinarily the abdominal pattern is indistinct with only some dark shadowing from dark hairs.

Chrysops celatus Pechuman
(Figs. 6, 15, 24)

Chrysops flavidus celatus Pechuman 1949: 82–83. Holotype female: Medford Lakes, New Jersey (CUIC); Pechuman 1957: 30, description of male.

Chrysops celatus: Teskey 1969: 34, description of larva and pupa.

Diagnosis.—Black and yellow, length 8–9.8 mm. Scape and pedicel not swollen, flagellum $\frac{1}{3}$ longer than scape and pedicel combined. Frontal callus spade shaped, width and height subequal. Mesoscutum greenish gray iridescent with black longitudinal stripes. Cells br and bm $\frac{1}{2}$ and $\frac{1}{5}$ infuscated basally.

Female.—Scape and pedicel not swollen, light brown, black setose, basal flagellomere light brown basally, black apically, apical flagellomeres black, 1.3 times length of basal flagellomere, antennal ratio 15:10:34. Frontoclypeus glossy yellow, eye margins bearing yellow tomentum that extends medianly be-

neath tentorial pits to frontoclypeal suture. Maxillary palp and labrum yellow. Frons predominantly yellow-gray tomentose with scattered yellow hair, slightly convergent above, height 1.5 times width at base. Frontal callus spade shaped, bulbous, yellow brown, width and height subequal. Vertex gray tomentose, except glossy brown integument associated with each ocellus which extends narrowly to upper margin of frontal callus. Mesoscutum greenish-gray iridescent, except lateral margins yellow tomentose, bearing 3 black longitudinal stripes, the median one narrow and flanked with gray. Scutellum black basally. Pleuron yellow tomentose. Legs mostly yellow, fore leg with tarsus and apical portion of tibia dark brown with black hair, mid and hind coxa brown, tarsus with black hairs. Wing pattern with broad apical spot entering apical half of 2nd submarginal cell, apex of hyaline triangle not reaching vein R_{2+3} , outer margin of brown crossband sinuous, 5th posterior cell infuscated basally, hyaline apically, cells br and bm $\frac{1}{2}$ and $\frac{1}{5}$ infuscated basally. Halter brown. Tergites 1–2 yellow brown, tergite 2 with darker median integumental marking appearing as an inverted “V” set over median yellow-

brown triangle, tergites 3–4 predominantly brown except for lighter posterior margin that expands medianly into light brown pollinose triangle, remaining tergites with anterior $\frac{2}{3}$ brown, posterior $\frac{1}{3}$ yellow-brown. Sternites yellow-brown pollinose with sternites 3–7 bearing narrow yellow pollinose line along the posterior margin, sternites 5–7 predominantly brown.

Male.—Similar to female except for the usual sexual differences and following characters. Length 6.5–7.5 mm. Pedicel only slightly shorter than scape, with finer, longer black hairs, length of basal flagellomere and combined apical flagellomeres subequal. Apical spot reaches posterior half of 2nd submarginal cell and then fades along hind margin, cells br and bm $\frac{3}{4}$ and $\frac{1}{2}$ infuscated basally. First tergite with dark spot under scutellum or entirely dark. Fifty percent of males examined with abdominal pattern of yellow and black with a black scutellum.

Material examined.—574 ♀, 30 ♂, examined from the following museums: AMNH, CASC, CNCI, CUCC, CUIC, FSCA, INHS, TAMU, UGCA, UNHC, USNM.

Distribution.—Massachusetts south to Florida, west to Texas; disjunct population in Michigan, southern Ontario, and northern Ohio, Illinois, and Indiana. I have examined specimens from the following states: AL, CT, DE, FL, GA, IN, KY, LA, MA, MD, MI, MS, NC, NH, NJ, NY, SC, TN, TX, and VA. L. L. Pechuman has recorded specimens from WV, and Ontario, Canada.

Biology.—Teskey (1969), based his description of the larva on 35 specimens. They were collected from 3 sites with fresh, standing water: wet sand, organic soil, and around roots of aquatic vegetation. In 1972, Teskey also collected larvae from the edge of a slow-moving stream in Virginia (Pechuman 1973).

The flight period for *Chrysops celatus* is late May to September in its northern range, and from April to late October in the south.

Peak flight time over its entire range is in June. Although it is a common species, it is not abundant enough to be considered a pest.

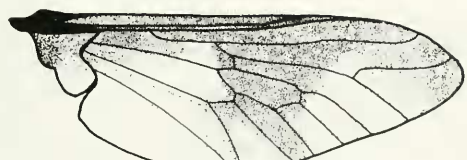
Discussion.—Pechuman (1949) first described *C. celatus* as a subspecies of *C. flavidus*, and it was so treated until Teskey (1969) found the larvae and pupae of the two subspecies to be specifically distinct. The adult of *C. celatus* most closely resembles *C. flavidus* and *C. reicherti*, and can be separated by its greenish-grey mesoscutum and the longer, more slender antennae. The sinuous outer margin of the crossband in *C. celatus* is similar to that of *C. reicherti*, but in *C. flavidus* this margin is either straight or concave. The larva resembles *C. flavidus* (Goodwin 1976) and *C. dixianus* (Teskey 1969).

The characters used to define *C. celatus* are consistent, in most cases, but there is some variation in the color pattern of the abdomen and wings, and in the color of the scutellum. The abdominal pattern on tergites 2–3 may vary from a black inverted "V" on the integument to lighter markings of dark hairs only. The apical spot of the wing may be extended and fade out along the hind margin of the wing, approaching a pattern much like that of *C. reicherti*. Specimens with this wing pattern tend to be more robust and have a more darkly infuscated wing. The scutellum, which is usually dark basally and reddish apically, is either wholly dark or reddish.

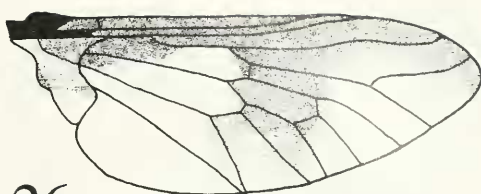
Chrysops dixianus Pechuman
(Figs. 7, 16, 25)

Chrysops dixianus Pechuman 1974: 185–187. Holotype female: Wedge Plantation, McClellanville, South Carolina (CUIC); Goodwin 1976: 345–347, description of larva and pupa.

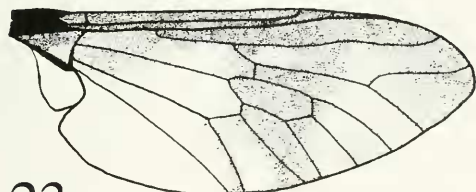
Diagnosis.—Yellow and brown species, length 6–8.5 mm. Antenna not swollen, flagellum $\frac{1}{3}$ longer than scape and pedicel combined. Frons width at base subequal to width at vertex. Hind coxa and femur dark



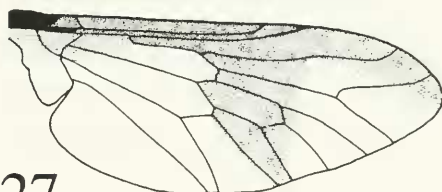
22 atlanticus



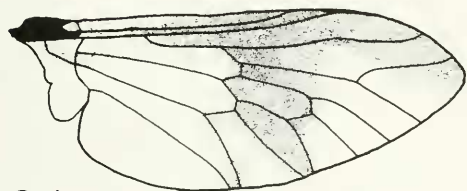
26 flavidus



23 brunneus



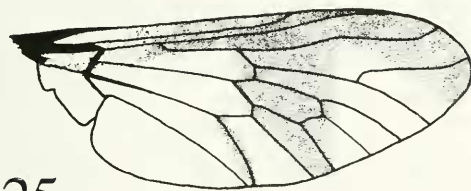
27 pudicus



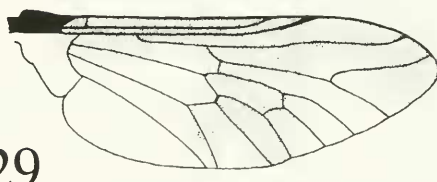
24 celatus



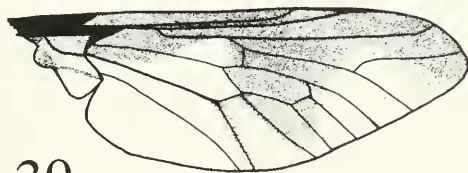
28 reicherti



25 dixianus



29 sandyi



30 tumidicornis

Figs. 22-30. Female wing patterns. 22, *Chrysops atlanticus*. 23, *C. brunneus*. 24, *C. celatus*. 25, *C. dixianus*. 26, *C. flavidus*. 27, *C. pudicus*. 28, *C. reicherti*. 29, *C. sandyi*. 30, *C. tumidicornis*.

brown. Wing picture with 5th posterior cell hyaline, infuscated area bordering vein Cu_2 .

Female.—Scape and pedicel not noticeably enlarged, yellow with black setae, basal flagellomere yellow basally, remainder brown, apical flagellomeres dark brown to black, flagellum approximately $\frac{1}{3}$ longer than length of scape and pedicel combined, antennal ratio 13:9:32. Frontoclypeus glossy yellow, eye margins bearing yellow tomentum that extends medianly beneath tentorial pits to frontoclypeal suture. Maxillary palp light brown with sparse black hair basally, more dense apically. Frons grayish-yellow pollinose with scattered yellow hairs, width at base subequal to width at vertex, height 1.15 times width at base. Frontal callus oval, slightly inflated, light brown, width 1.4 times height. Vertex yellow gray, glossy surrounding each ocellus, ocelli yellow. Mesoscutum yellow-gray tomentose in ground color with 3 dark brown longitudinal stripes, median one flanked with lighter shade of brown, the two sub-lateral stripes merge with median one near the scutellum, yellow hair scattered over entire mesoscutum. Scutellum dark brown basally, light brown apically. Pleuron yellow-gray tomentose. Fore coxa and femur yellow, fore tibia with basal $\frac{1}{2}$ yellow, apical $\frac{1}{2}$ and fore tarsus dark brown, bearing black hair. Mid coxa dark brown, femur, tibia and metatarsus yellow, remainder of tarsus dark brown. Hind coxa and femur dark brown, tibia light brown basally, darkening to apex, metatarsus light brown, remaining portion of tarsus dark brown, tibia and tarsus bearing stiff black hair. Wing pattern distinct, apical spot broad, filling half of 2nd submarginal cell, hyaline triangle not quite reaching vein R_{2+3} , outer margin of crossband straight or convex, 5th posterior cell hyaline, vein Cu_2 infuscated along border, cells br and bm $\frac{1}{3}$ and $\frac{1}{5}$ infuscated basally respectively. Halter with stalk brown, knob dark brown. Abdominal pattern distinct, tergite 1 yellow, light brown under scutellum, tergite 2 with anterior half entirely yellow, posterior half

yellow with 2 median oblique dark brown dashes making a flattened inverted "V" not reaching posterior margin of tergite, posterior margin with median yellow triangle and 2 submedian brown spots, tergite 3 with wide dark brown band that narrows medianly, not reaching anterior or posterior margins, posterior margin yellow, tergites 4–5 with anterior $\frac{2}{3}$ dark brown, remaining $\frac{1}{3}$ yellow, tergites 6–7 dark brown. Sternites 1–4 yellow, 4th sternite with dark brown median spot, 5th sternite brown with yellow hind margin, remaining sternites dark brown.

Male.—Not previously described. Length 7.4 mm. Scape and pedicel not noticeably enlarged, yellow with black hair, basal flagellomere yellow at base, remainder brown, apical flagellomeres black, antennal ratio 15:12:34. Maxillary palp yellow with long yellow hair and a few black hairs, length twice width. Mesoscutum yellow-gray tomentose, above wing bases yellow tomentose, with 3 dark brown longitudinal stripes that merge at the base near the scutellum. Scutellum dark brown at base, reddish brown apically. Fore coxa and femur yellow, tibia with basal $\frac{1}{2}$ yellow, apical $\frac{1}{2}$ and tarsus dark brown, bearing black hair. Mid coxa dark brown, femur, tibia and metatarsus yellow, remainder of tarsus dark brown. Hind coxa and femur dark brown, tibia light brown basally, darkening to apex, metatarsus light brown, remaining portion of tarsus dark brown, tibia and tarsus bearing stiff black hair. Wing pattern with cells br and bm $\frac{1}{2}$ and $\frac{1}{4}$ infuscated basally, hyaline triangle reaching vein R_{2+3} , infuscated area bordering Cu_2 vein wider than in female. First abdominal tergite yellow, with light brown shading under scutellum, 2nd tergite with anterior $\frac{1}{2}$ yellow, posterior $\frac{1}{2}$ with 2 median oblique dark brown dashes not attaining posterior margin of tergite, posterior margin with vague, median yellow triangle, tergite 3 with wide dark brown median band not reaching anterior or posterior margins, bordered laterally by black setae, hind margin

yellow, tergites 4–5 with anterior $\frac{2}{3}$ dark brown, remaining $\frac{1}{3}$ yellow, tergites 6–7 dark brown. Sternites 1–3 yellow, the 3rd sternite with a dark brown median spot, sternites 5–6 brown with yellow hind margin, remaining sternite dark brown. Based on 1 specimen from Alachua Co. Florida, collected by G. B. Fairchild, V-24/25-1975, (FSCA).

Material examined.—468 ♀, 1 ♂, examined from the following museums: AMNH, CNCI, CUCC, CUIC, FSCA, INHS, TAMU, UGCA, UNHC, USNM.

Distribution.—Virginia to Florida, west to Louisiana and Arkansas. I have examined specimens from: AL, AR, FL, GA, LA, MS, NC, and SC. L. L. Pechuman has locality data from VA.

Biology.—Little is known about the biology of *Chrysops dixianus*. The larva was taken from the edge of a freshwater lake in mud and decomposing leaves (Goodwin 1976). Pechuman (1974) stated that *C. dixianus* could be a common pest, as suggested by 124 specimens collected on July 6, 1971, in Berkeley County, South Carolina, by D. C. Sheppard.

Discussion.—This species was once confused with *C. pudicus* but differs in having a longer, thinner flagellum, a brown mesoscutum, and the anterior portion of tergite 2 without markings. The adult of *C. dixianus* appears most similar to *C. reicherti*. The 2nd abdominal tergite of both has markings only on the posterior $\frac{1}{2}$, but *C. dixianus* is smaller, has a defined apical spot, and the 5th posterior cell is hyaline.

There is little variation in this species. The mesoscutum, normally with a narrow median brown stripe, may have the stripe as wide as the two sublaterals. The scutellum may be all dark, and the abdominal markings on tergites 2–3 can vary from median dashes to a more extensive pattern reaching the lateral margins. The hind femur can be up to $\frac{1}{2}$ light brown.

Chrysops flavidus Wiedemann
(Figs. 8, 17, 26)

Chrysops flavidus Wiedemann 1821: 55.
Holotype female: Savannah, Georgia

(MZLU); Kröber 1926: 291–292, redescription; Teskey 1969: 39, description of larva and pupa.

Chrysops pallida Macquart 1838: 162 (1838: 166). Holotype female: locality unknown (MNHN). Synonymized by Philip 1965: 325.

Chrysops pallidus Bellardi 1859: 73. Holotype female: Mexico (MRSN). Preoccupied by Macquart 1838.

Chrysops guiterasi Brunetti 1923: 401. Syntypes female and male: Manzanillo, Cuba, ♀ (BMNH), ♂ (ZMHB). Synonymized by Bequaert, 1940: 279.

Diagnosis.—Light brown, length 8–10 mm. Scape and pedicel slightly swollen. Mesoscutum yellow with brown stripes. Hind margin of crossband straight or concave, cells br and bm $\frac{1}{2}$ and $\frac{1}{3}$ infuscated basally.

Female.—Scape slightly enlarged, scape and pedicel light brown, black setose, basal flagellomere light brown, apical flagellomeres black, equal to or longer than basal flagellomere, antennal ratio 15:10:30. Frontoclypeus glossy yellow, eye margins bearing yellow tomentum that extends medianly beneath tentorial pits to frontoclypeal sutures. Maxillary palp and labrum yellow. Frons predominantly yellow tomentose, slightly convergent above, height 1.28 times width at base. Frontal callus oblong, bulbous, light brown, width 1.83 times height. Vertex yellow tomentose, except glossy around each ocellus, ocelli black. Mesoscutum yellow tomentose, yellow pilose, bearing three subshiny brown longitudinal stripes, median one narrower than the sublaterals. Scutellum yellow basally, orange-yellow apically. Pleuron yellow tomentose. Legs predominantly yellow, mid and hind coxa brown, hind tibia with scattered black hair apically, fore, mid, and hind tarsi with black hair. Wing pattern with clearly defined hyaline areas, apical spot entering posterior half of 2nd submarginal cell, apex of hyaline triangle not quite reaching vein R_{2+3} , outer margin of cross-

band straight or slightly concave, 5th posterior cell infuscated basally, hyaline apically, cells br and bm $\frac{1}{2}$ and $\frac{1}{3}$ infuscated basally. Halter with brown knob and yellow stalk. Abdominal tergites golden brown, tergites 2–5 with median yellow pollinose triangles, each triangle outlined submedianly with indistinct brown spots, first tergite with two submedian brown spots, hind margin of tergites 3–6 narrowly yellow tomentose, tergites bearing mixed black and yellow hairs. Sternites golden yellow tomentose, sternites 2–6 bearing a narrow yellow posterior border, sternites 4–5 with median indistinct brown spot.

Male.—Similar to female except for the usual sexual differences and the following characters. Length 6.5–7.2 mm. Scape and pedicel with longer, finer, black hair. Wing faintly tinted below the apical spot and along the hind margin, basal $\frac{1}{2}$ of cell br infuscated. Abdomen without distinct median triangles.

Material examined.—1,245 ♀, 75 ♂ examined from the following museums: AMNH, BMNH, CASC, CNCI, CUCC, CUIC, FMNH, FSCA, INHS, OSUC, TAMU, UGCA, UNHC, USNM.

Distribution.—Missouri to Massachusetts south to Texas, Florida, Mexico, the Bahamas, Belize, and Cuba. I have examined specimens from AL, AR, DE, FL, GA, IL, IN, KS, LA, MA, MD, NC, NJ, NY, OK, SC, TN, TX, VA, Belize, the Bahamas, and Cuba. L. L. Pechuman recorded specimens from CT, IA, KY, MO, MS, OH, PA, RI, WV, and Mexico.

Biology.—The larva described by Teskey (1969) was taken from sand on the edge of a pond. Tidwell (1973) collected most of the Louisiana specimens from the banks of ponds and waterways in bottomland hardwood forests associated with the Mississippi flood plain. Jones and Bradley (1923) reared a larva found at the bottom of a brook. Jones and Anthony (1964) collected larvae from the margins of brackish water and from highly alkaline soil and reared 38

specimens whose pupal period averaged 8 days.

Adults in northern regions, are active from June to October and most abundant in July. In the south they fly as early as March and continue until late September. In some areas of Florida there are two distinct population peaks of *Chrysops flavidus*, one occurring in April and May, the other in August and September (Jones and Anthony 1964).

This species was described as pestiferous to humans (Hine 1906, Jones and Anthony 1964), generally attacking the head and neck, and considered one of the worst "stock pests" in the genus *Chrysops* (Hine 1906).

Discussion.—*Chrysops flavidus* is most commonly confused with *C. atlanticus*, *C. reicherti* and *C. celatus*, all considered at one time to be either subspecies or varieties of *C. flavidus*. It is also similar to *C. sandyi*, described below. *Chrysops flavidus* differs from *C. atlanticus* in having thinner antennae, a yellow mesoscutum, and a wing pattern with well defined hyaline areas. *Chrysops flavidus* differs from *C. celatus* in its shorter, stouter antennae, yellow mesoscutum, straight or slightly concave outer margin of the crossband, and its less distinct abdominal pattern. It differs from *C. reicherti* in having the outer margin of the crossband straight or slightly concave, yellow hind femur, and an inverted "V" pattern that reaches the anterior half of tergite 2. *Chrysops flavidus* differs from *C. sandyi* in its larger size, yellow mesoscutum with dark brown stripes, and its more divergent frons with the width at the vertex greater than the width of the basal callus.

Variation in *C. flavidus* is found in the tinting of the wing and in the abdominal color pattern. Approximately 10% of the specimens examined had tinting of the wing below the apical spot, approaching the smoky wing pattern of *C. atlanticus*. However, *C. flavidus* has a consistently straight or slightly concave outer margin of the crossband and yellow mesoscutum. Speci-

mens with the apical portion of the wing tinted have been collected from the coastal areas of South Carolina, Georgia, and Florida. A collection of 27 specimens from Monroe County, Florida, exhibit a tinted wing, have a stouter scape, a grayer mesoscutum, and a reddish brown abdomen. Other than these differences, these specimens do not vary in size and other characters.

The female syntype of *Chrysops guiterasi*, described from Cuba and considered a synonym of *C. flavidus*, was examined. I have no doubt it is conspecific with *C. flavidus*, although the abdomen is reddish-brown.

Chrysops pudicus Osten Sacken
(Figs. 9, 18, 27)

Chrysops pudicus Osten Sacken 1875: 381–382. Lectotype female: Beverley, Massachusetts, (MCZC). Lectotype examined, missing head; Goodwin 1976: 350–351, description of pupa.

Diagnosis.—Brown and black, length 6.5–8.2 mm. Frontal callus reddish-brown with black upper margin. Mesoscutum steel gray with black stripes. Hyaline triangle reaches vein R_{2+3} , apical spot narrowly enters 2nd submarginal cell. Cells br and bm $\frac{1}{2}$ and $\frac{1}{6}$ infuscated basally.

Female.—Scape and pedicel slightly swollen, ground color shiny brown, bearing stiff black hairs, basal flagellomere light brown gradually darkening at apex, apical flagellomeres black, flagellum subequal to length of scape and pedicel combined, antennal ratio 13:9:23. Frontoclypeus glossy reddish brown, eye margins bearing light brown tomentum that extends medianly beneath tentorial pits to frontoclypeal suture. Maxillary palp yellow. Frons light brown tomentose, yellow pilose, slightly convergent above, length 1.3 times width at base. Frontal callus oblong, bulbous, reddish brown with black upper margin, margin concolorous with smooth integument surrounding ocelli. Vertex dark brown, glossy

around each ocellus, ocelli black. Scutellum black. Fore coxa light brown, trochanter slightly darker, femur light brown, apical $\frac{1}{4}$ darker brown, tibia with black hair apically, tarsi black, mid coxa dark brown, femur light brown with scattered stiff yellow hair, tibia light brown with short black setae apically, tarsus light brown basally, dark brown apically, covered with black setae, hind femur dark brown with yellow hair, tibia light brown with yellow hair basally, remainder with yellow and black hair, tarsus light brown basally, black apically. Wing pattern with clearly defined hyaline areas, apical spot narrow, entering extreme apical portion of 2nd submarginal cell, hyaline triangle reaches vein R_{2+3} , outer margin of crossband straight or slightly concave from vein R_{2+3} to vein M_3 , cell br and bm $\frac{1}{2}$ and $\frac{1}{6}$ infuscated basally. Abdomen with first 2 segments yellow, 1st tergite with large black spot under scutellum not reaching posterior margin, extending laterally to approximately $\frac{1}{2}$ width of tergite, 2nd tergite with black integumental inverted "V" not reaching anterior or posterior margin, black hair scattered over black integumental pattern, orange median triangle under black inverted "V" pattern, tergites 3–4 black anteriorly with median orange triangle posteriorly, black pattern not reaching lateral margin of the tergite, tergites 5–6 black anteriorly, yellow posteriorly. Abdomen yellow ventrally, sternites 3–4 with median black spot, spot on sternite 3 smaller than on sternite 4, remaining sternites black.

Male.—Similar to female except for the usual sexual characteristics and the following characters. Scape and pedicel covered with long, fine, black hair. Mesoscutum almost entirely black, the 3 stripes indistinct, with scattered yellow hair. Apical spot slightly more extensive. Cell br $\frac{3}{4}$ infuscated basally.

Material examined.—91 ♀, 1 ♂ examined from the following collections: CUIC, FSCA, UNHC.

Distribution.—Southern Illinois to Mas-

sachusetts, south to eastern Texas and Florida with some disjunct populations in northern Indiana, Michigan, New York, southern Ontario, and Nova Scotia. I have examined specimens from AL, CT, FL, GA, LA, LA, NC, NH, NY, RI, SC, and Nova Scotia. L. L. Pechuman has records from NJ, DE, IN, IL, MD, MI, MS, OK, TN, TX, and WI.

Biology.—The larva of this species, although not formally described, has reportedly been taken from wet soil along a roadside ditch (Jones and Anthony 1964, Pechuman 1973). The pupa was described by Goodwin (1976) from Baldwin County, Alabama, but the habitat is unknown. Jones (1953) indicated that in parts of Florida there are two generations of *C. pudicus* annually, one that emerges in May–June and another in August–September. Large numbers can occur in wooded areas of Florida during April and May (Jones and Anthony 1964).

Discussion.—Pechuman et al. (1983) treated *C. pudicus* as a member of the *Chrysops callidus* group, which includes *C. dimmocki* Hine, a species that can resemble *C. pudicus*. Members of the *C. callidus* group all have a black frontal callus, inverted “V” pattern on 2nd abdominal tergite that reaches the anterior margin and, in some species, a hyaline triangle that extends beyond vein R_{2+3} . *Chrysops pudicus* differs from members of the *C. callidus* group in having an abdominal pattern on tergite 2 not reaching the anterior margin, a hyaline triangle not crossing vein R_{2+3} , and a yellow frontal callus with dark top margin. The frontal callus is rarely entirely dark (Brennan 1935, Teskey 1990), and the hyaline triangle rarely reaches beyond vein R_{2+3} . Therefore, I have chosen to place *C. pudicus* in the *Chrysops flavidus* group.

Chrysops pudicus most closely resembles *C. tumidicornis*, described below, in having similar size, dark coloration, and 1st abdominal tergite with a dark spot under the scutellum. They differ in that *C. pudicus* has a narrower scape and pedicel, a less ex-

tensive, well defined apical spot, and a hyaline triangle that reaches R_{2+3} .

Variation within *C. pudicus* occurs in the extent of the hyaline triangle (Pechuman 1973) and in the color of the frontal callus. Of the 91 females examined, 10 specimens from Florida had a hyaline triangle that did not reach vein R_{2+3} . Although variation in color of the frontal callus is mentioned in various publications (Brennan 1935, Teskey 1990), all the specimens I examined had a yellow frontal callus with a dark upper margin.

Chrysops reicherti Fairchild
(Figs. 10, 19, 28)

Chrysops reicherti Fairchild 1937: 60–61.

Holotype female: Monticello, Jefferson County, Florida (MCZC). Holotype examined. Goodwin 1972: 105–107, description of larva and pupa.

Chrysops flavida reicherti: Philip, 1947: 273, treated as a subspecies. Pechuman 1957: 30–31, description of male; Philip 1965: 325, treated as a variety of *C. flavidus*.

Diagnosis.—Yellow and brown, length 8–9.5 mm. Antenna not swollen. Mesoscutum yellow in ground color with 3 brown stripes. Tergites 1–2 light yellow, darker pattern on posterior half of tergite 2. Cells br and bm are $\frac{1}{3}$ and $\frac{1}{4}$ infuscated basally.

Female.—Scape and pedicel not swollen, light brown with black setae, flagellum black, antennal ratio 15:10:35. Frontoclypeus glossy yellow, eye margins bearing grayish yellow tomentum extending medianly beneath tentorial pits to frontoclypeal suture. Maxillary palp brown. Frons yellow tomentose, slightly convergent above, height 1.3 times width at base. Frontal callus oblong, bulbous, light brown, width 1.33 times height. Vertex light brown around each ocellus, ocelli yellow. Mesoscutum yellow tomentose with three subshiny brown longitudinal stripes, median one narrower than sublaterals, flanked with

lighter shade of brown. Scutellum yellow brown. Pleuron yellow tomentose. Legs predominantly light brown, fore and mid tarsi brown, mid and hind tibiae with dark hair apically, hind femur reddish brown, apical tarsomeres brown to black. Wing with extensive apical spot reaching posterior $\frac{1}{2}$ of 2nd submarginal cell fading into 3rd posterior cell, hyaline triangle not reaching vein R_{2+3} , outer margin of crossband bowed outward at center, 5th posterior cell infuscated basally and along vein margins, hyaline apically, cells br and bm $\frac{1}{3}$ and $\frac{1}{4}$ infuscated basally. Halter with brown stalk and knob. First abdominal tergite light brown, second tergite with basal half yellow, green tinted medianly, apical half with oblique brown spots reaching hind margin and enclosing pale triangle. Tergite 3 with brown median band set over median orange triangle, hind margin of tergite gray. Tergites 4–6 with basal half brown, apical half yellow. Sternites predominantly golden brown, 3–6 with median brown spot progressively enlarged on posterior segments.

Male.—Similar to female except for the usual sexual differences and the following characters: Length 6.5–7.0 mm. Scape swollen, pedicel $\frac{1}{5}$ longer than in female, scape and pedicel with longer, finer, black hair. Mesoscutum with long yellow hair. Wing with apical spot more extensive, cells br and bm $\frac{1}{2}$ and $\frac{1}{3}$ infuscated basally.

Material examined.—720 ♀, 20 ♂ examined from the following collections: CASC, CNCI, CUIC, FSCA, INHS, TAMU, UGCA, UNHC, USNM.

Distribution.—Southern Illinois to Delaware, south to eastern Texas and Florida. I have examined specimens from AL, AR, FL, GA, IL, KY, LA, MA, MD, MS, NC, SC, TN, TX, and VA. L. L. Pechuman has records from IN and MO.

Biology.—The larvae of *Chrysops reicherti* have been collected in very wet mud and organic debris from small ponds and lakes (Goodwin 1972, Tidwell 1973). Adults have been collected between April and September in the southern states. The

one Massachusetts specimen was collected on May 8.

Discussion.—*Chrysops reicherti* was originally described as a species by Fairchild (1937). Philip (1947) listed it as a subspecies of *C. flavida*. Goodwin (1972), after describing the larva and pupa of *C. reicherti* and comparing them to those of *C. flavidus*, considered them separate species and elevated *C. reicherti* to a full species.

Chrysops reicherti is most commonly confused with *C. flavidus*, but is separated by its pale yellow first two abdominal segments, sinuous outer margin of the crossband, and the slightly darker hind femora. In the key above, *C. reicherti* shares with *C. dixianus* the color pattern on the posterior portion of the second tergite. They differ in that *C. dixianus* has a straighter outer margin of the crossband, an apical spot that reaches slightly beyond the apex of the wing, and 5th posterior cell extensively hyaline.

Variation in *C. reicherti* includes tinting in the usual hyaline areas of the wing, 2nd abdominal tergite without the greenish cast described by Fairchild and, hind femur light or dark brown.

Chrysops sandyi Baier, new species (Figs. 12, 20, 29)

Diagnosis.—Yellow and brown, length 6–8 mm. Antenna slightly enlarged. Mesoscutum with brown iridescent stripes. Wing slightly tinted in usual hyaline areas. Cells br and bm are $\frac{1}{2}$ and $\frac{1}{3}$ infuscated basally.

Holotype female.—Length 6.2 mm. Scape slightly enlarged, antenna light brown except apical $\frac{3}{4}$ of 1st flagellomere slightly darker, apical 4 flagellomeres black, antennal ratio 13:9:24, length of flagellum subequal to combined length of scape and pedicel. Frontoclypeus glossy yellow, eye margins bearing yellow tomentum that extends medianly beneath tentorial pits to frontoclypeal suture. Maxillary palp light brown with sparse black hairs, length 4 times width. Frons yellow tomentose with

scattered yellow hairs, convergent above, height slightly more than width at base, width at vertex less than width of frontal callus. Frontal callus oval, yellow brown, width 1.7 times height. Vertex yellow tomentose, glossy around each ocellus, ocelli light brown. Mesoscutum yellow-green iridescent tomentose, except lateral margins iridescent yellow gray, bearing 3 brown to dark brown stripes, the median one darker and narrower than the two sublaterals. Scutellum dark brown basally, brown apically. Pleuron yellow gray. Legs mostly light brown, fore tarsus black, apical portion of tibia dark brown with black hair, mid coxa dark brown, tarsus with black hair, hind coxa dark brown, femur and basal tibia reddish brown, apical tibia brown, apical tibia and tarsus with black hair. Wing with broad apical spot reaching posterior half of 2nd submarginal cell, apex of hyaline triangle including posterior half of 1st submarginal cell, not reaching vein R_{2+3} , outer margin of crossband straight, 5th posterior cell slightly tinted, infuscated along vein Cu_2 , cells br and bm $\frac{1}{2}$ and $\frac{1}{3}$ infuscated basally. Halter with light brown stalk and brown knob. Tergites 1–2 yellow brown, tergite 1 with a few dark hairs under scutellum, tergite 2 with a median brown integumental marking appearing as a flattened inverted "V", not reaching anterior margin, fading into pale posterior margin, median orange-brown triangle behind inverted "V" pattern, tergite 3 mottled dark brown anteriorly, orange brown posteriorly, extending medianly to form orange triangle, tergites 4–6 dark brown anteriorly, yellow orange posteriorly, tergites 3–6 with gray hind margin. Sternites 1–3 yellow brown, sternite 3 bearing a median brown spot, sternites 4–7 dark brown, posterior margin pale yellow tomentose.

Male.—Unknown

Material examined.—Holotype ♀, ALABAMA: Mobile County, VII-1952, T. R. Adkins (CUIC). Paratypes: 105 ♀. ALABAMA: Mobile County, VII-1952 (62 ♀), VII-24-1952 (4 ♀), T. R. Adkins (CUIC); 1

♀ Corden, VII-8-1962, M. Tidwell (FSCA). LOUISIANA: St. Tammany Parish, 4 ♀ Slidell, 7 mi SE, VI-23-1980, E. A. Lisowski (CUIC). MISSISSIPPI: Hancock County, Ansley, VI-10-1966 (5 ♀), VI-20-1966 (6 ♀), Diamond & Bradford (FSCA); 2 ♀ V-5-1976, M. Tidwell (FSCA); 1 ♀ Pearlinton, VI-9-1966, ? collector (FSCA); 1 ♀ MTO fee area, IV-27-1965, R. Hepburn (FSCA). Jackson County, Fountainbleau, VI-26-1966 (2 ♀), VII-27-1968 (1 ♀), B. Byrd (FSCA); 4 ♀ Gautler, 4.5 mi WSW, VI-24-1980, E. A. Lisowski (CUIC); 12 ♀ Ocean Springs, V-10-1970, G. Ross (FSCA).

Etymology.—Named in honor of G. B. "Sandy" Fairchild for his extensive contribution to the organization of *Chrysops* taxa and his desire to see the southeastern species clarified. His examination of specimens and critical comments on this work has been greatly appreciated.

Distribution.—Gulf coast of Alabama, Mississippi, and Louisiana.

Biology.—*Chrysops sandyi* has been collected between April 27 and August 8. Based on its distribution along the Gulf coast, it is probably limited to a littoral environment.

Discussion.—This species has been confused with *C. atlanticus* because of the tinted wing and greenish iridescent color of the mesoscutum. *Chrysops sandyi* has a narrower antennae, the pedicel $\frac{3}{4}$ the length of the scape, longer palpi, length 4 times width of apical palpomere, mesoscutum with brown longitudinal stripes, and lightly tinted wing pattern. *Chrysops atlanticus* inhabits the Atlantic coast from Maine to Florida while *C. sandyi* is found along the Gulf coast of Alabama, Mississippi, and Louisiana.

Variation in *C. sandyi* occurs in the ground color of the mesoscutum, and in the abdominal pattern. Ground color of the mesoscutum, although usually greenish iridescent, may have yellow tomentum. Abdominal pattern may be indistinct, with a pattern of black hair and no integumental markings.

Specimens with these features appear similar to *C. flavidus*, but *C. sandyi* is smaller, wing tinted in the usual hyaline areas, and flagellum subequal to the combined length of the scape and pedicel.

Chrysops tumidicornis Baier,
new species

(Figs. 11, 21, 29)

Diagnosis.—Black and brown, length 5.8–8 mm. Antenna swollen, pedicel barrel shaped. Frontal callus width approximately 2 times height. Mesoscutum grey green with black stripes. Wing with distinct hyaline triangle, cells br and bm $\frac{2}{3}$ and $\frac{1}{4}$ infuscated basally.

Holotype female.—Length 7.4 mm. Scape and pedicel swollen, pedicel barrel shaped, brown, covered with black setae, basal flagellomere brown, apical 4 flagellomeres black, flagellum subequal to length of scape and pedicel combined, basal flagellomere equal to combined length of the apical 4 flagellomeres, antennal ratio 14:11:26. Frontoclypeus glossy yellow, eye margins bearing yellow tomentum that extends medianly beneath tentorial pits to frontoclypeal suture. Maxillary palp light brown with scattered stiff black hairs, length 4 times width of apical palpomere. Frons yellow tomentose, slightly convergent above, height 1.2 times width at base. Frontal callus oval, slightly bulbous, yellow, width 1.9 times height. Vertex yellow brown except glossy black around each ocellus, ocelli black. Mesoscutum grayish-green ground color with 3 longitudinal black stripes not merging basally, median one narrower than two sublaterals, yellow tomentose above wing bases. Scutellum black basally, reddish brown apically. Fore coxa, femur and basal $\frac{1}{3}$ of tibia yellow, remaining tibia brown, black setose, tarsus entirely dark brown, black setae, mid coxa brown, femur, tibia and basal tarsomeres yellow, tarsi and apical $\frac{1}{4}$ of tibia with black setae, hind coxa, femur and tibia brown, scattered yellow hair and black setae, black setae becoming more dense toward apical portion

of tibia and tarsus. Wing pattern distinct, apical spot includes apical $\frac{3}{4}$ of vein R_4 , reaching posterior half of 2nd submarginal cell, and fading along hind margin of wing to crossband, hyaline triangle slightly tinted, not reaching vein R_{2+3} , outer margin of crossband straight, 5th posterior cell infuscated along margins, center hyaline, cells br and bm $\frac{2}{3}$ and $\frac{1}{4}$ infuscated basally respectively. Abdominal tergites orange yellow, 1st tergite dark brown under scutellum, tergite 2 with median black inverted “V” pattern on integument not reaching anterior, posterior or lateral margins, scattered black hair over dark pattern, median orange triangle behind inverted “V” pattern, hind margin gray, tergite 3 with gray posterior border widened medianly to form an indistinct triangle, anterior half with black pattern of 2 half circles that merge above triangle and occupy $\frac{1}{3}$ width of tergite, tergites 4–6 black anteriorly, posterior border gray. Abdomen orange yellow ventrally, sternites 3–5 with median dark spot becoming wider on each successive sternite, sternites 6–7 dark brown.

Male.—Unknown.

Material examined.—Holotype ♀, FLORIDA: Levy County, Cedar Key Shell Mound, VII-7-1976, R. H. Roberts (FSCA). Paratypes: 206 ♀. FLORIDA: Bay County, 2 ♀ V-14-1957, F. W. Mead (CASC); 1 ♀ V-25-1982, J. Hogsette (FSCA); Saint Andrews St. Park, 1 ♀ V-14-1957, F. W. Mead (CASC). Citrus County, 3 ♀ Ozello, VII-29-1959, H. V. Weems (CASC). Collier County, 1 ♀ Collier-Seminole State Park, XI-26-1976, John Edward Rawlins (CUIC). Dade County, 1 ♀ Everglades National Park, I-29-1959, H. A. Denmark (CASC); 1 ♀ Royal Palm Hammock, VI-22-1951, Price, Beamer & Wood (CASC); 1 ♀ West Lake, XII-4-1970, P. H. & M. Arnaud (CASC). Dixie County, 2 ♀ Jena, VII-27-1991, Jena, 10 mi S on RT 361, VII-22-1985 (2 ♀), VII-13-1991 (8 ♀), VII-21-1991 (5 ♀), VII-27-1991 (4 ♀), VIII-31-1991 (13 ♀), VII-11-1992 (1 ♀) L. R. Davis, Jr. (FSCA); 3 ♀ Suwannee, V-19-1964,

C. F. Zeiger (CASC); 2 ♀ Suwannee, V-19-1964 (FSCA). Franklin County, Carrabelle, IV-25-1980 (2 ♀), IV-27-1980 (3 ♀), IV-28-1980 (1 ♀), IV-29-1980 (4 ♀), V-4-1980 (5 ♀), IV-14-1977 (1 ♀), L. L. Pechuman (CUIC); IV-28-1980 (1 ♀), V-4-1980 (1 ♀), L. L. Pechuman (FSCA); Eastpoint, 1 ♀ V-19-1935 (FSCA); Lake Morality, IV-27-1980 (1 ♀), V-10-1980 (1 ♀), 1 ♀ Timber Island, V-4-1980, L. L. Pechuman (CUIC); 1 ♀ Timber Island, V-4-1980, L. L. Pechuman (CASC); 2 ♀ St. George Island, IV-5-1976, L. L. Pechuman (FSCA). Gilchrist County, 1 ♀ VI-2-1950, (CASC). Gulf County, 4 ♀ V-11-1973, J. T. Goodwin (FSCA), V-4-1973 (1 ♀), VIII-14-1971 (1 ♀), H. V. Weems, Jr (FSCA). 2 ♀ St. Joseph State Park, V-1/3-1970, W. W. Wirth (USNM); 1 ♀ V-5-1987, L. Strange and J. Wiley (FSCA). Hernando County, 1 ♀ Bayport, IV-22-1978, L. A. Strange (FSCA). Hillsborough County, 1 ♀ Tampa, IV-29-1950, G. B. Worth (CASC). Jefferson County, 1 ♀ Monticello, IX-18-1935, G. B. Fairchild (FSCA). Lee County, 2 ♀ Sanibel Island, IV-8-1933, W. J. Clench (USNM); 2 ♀ Sanibel Island IV-8-1933, W. J. Clench (FSCA). Levy County, 2 ♀ VII-8-1980, E. Davis (FSCA); 1 ♀ V-6-1955, H. V. Weems (FSCA); 3 ♀ Cedar Key VI-20-1974, (FSCA); 5 ♀ Cedar Key area, VI-4-1991, J. Huether (CUIC); 3 ♀ Cedar Key, VII-12-1939, R. H. Beamer (CASC); 3 ♀ VI-12-1939, Oman (USNM); 1 ♀ VII-29-1977, L. R. Davis, Jr. (FSCA); 1 ♀ VI-28-1973, Carl Shleck (FSCA); 1 ♀ VI-15-1979, L. A. Wood (FSCA); Cedar Key, Shell Mound, VI-9-1971 (5 ♀), VI-16-1973 (1 ♀), VI-29-1976 (6 ♀), VII-3-1976 (7 ♀), G. B. Fairchild (FSCA); 1 ♀ 3 mile E. Shell Mound, 2 ♀ VI-9-1971, (FSCA); 8 ♀ VII-7-1976, R. Roberts (FSCA); 3 ♀ VI-21-1973, R. Wilkerson (FSCA); Yankeetown, V-8/13-1980 (1 ♀), VII-8-1980 (1 ♀), V-16-1980 (3 ♀), VI-24-1980 (5 ♀), E. Davis (FSCA); V-21/23-1979 (1 ♀), V-14/16-1979 (2 ♀), V-11/14-1979 (1 ♀), V-23/24-1979 (3 ♀), V-25/30-1979 (2 ♀), V-30/31-1979 (1 ♀), Roberts (FSCA); 3 ♀ V-30/31-1985, D. L.

Kline (FSCA); VIII-10-1966 (1 ♀), VII-28-1965 (4 ♀), C. F. Zeiger (FSCA). Manatee County, 1 ♀ VI-12-1925, T. H. Hubbell (CASC). Monroe County, 1 ♀ Everglades National Park, IV-8-1970, W. W. Wirth (USNM). Okaloosa County, 4 ♀ V-12-1972, J. T. Goodwin (FSCA). Pasco County, 5 ♀ Hudson, VII-13-1939, R. H. Beamer (CASC); 11 ♀ VII-13-1939, Oman (USNM); 1 ♀ VII-13-1939, Oman (FSCA); 2 ♀ VII-13-1939, D. E. Hardy (CASC). Pinellas County, 1 ♀ IV-19-1930, B. P. Moora (USNM); 1 ♀ V-2-1955, R. P. Essar (FSCA); 1 ♀ V-10-1955, E. W. Holder, Jr. (FSCA); 1 ♀ Dunedin, V-14-1959, O. L. Cartwright (USNM); 2 ♀ Pass-a-grille, IV-7-1930, W. G. Fargo (CASC). Santa Rosa County, 1 ♀ Santa Rosa Island, V-24-1971, H. V. Weems Jr. (FSCA); Taylor County, 1 ♀ Steinhatchee, VII-12-1966, R. P. Esser (CASC); 1 ♀ Steinhatchee, VII-20-1991, L. R. Davis, Jr. (FSCA); 1 ♀ 12 mi NW of Steinhatchee, V-24-1983, R. M. Reeves (UNHC); 12 ♀ Cedar Island, 16 miles NW of Steinhatchee, V-16-1969, H. V. Weems, Jr. (FSCA); 3 ♀ Cedar Island, 16 miles NW of Steinhatchee, V-16-1969, H. V. Weems, Jr. (CASC). Wakulla County, 1 ♀ V-2-1980, L. L. Pechuman (CUIC); 3 ♀ Ochlockonee River State Park, V-20-1968, H. V. Weems, Jr. (FSCA); 2 ♀ Ochlockonee River State Park, V-20-1968, H. V. Weems, Jr. (CASC); 1 ♀ Ochlockonee River State Park, VI-22-1973, Fairchild & Wilkerson (FSCA).

Etymology.—This species is named for its characteristic "robust" pedicel.

Distribution.—West coast of Florida.

Biology.—Based of the collection data, most adults have been taken between April–August with a few collected in September, and November–January. All specimens examined were taken from coastal counties near brackish habitats. Although the larva and pupa are unknown, I suspect this species is limited to salt marshes.

Discussion.—This species has been confused with *C. atlanticus* because they both have swollen antennae. Also, I believe that

Pechuman (1949), in his description of *C. atlanticus*, had before him specimens of this species. He wrote that many specimens examined showed considerable melanism, varying from slight enlargement of abdominal spots to extreme enlargement where the tergites were mostly dark with a narrow yellow-brown margin, a pattern I find to be diagnostic *C. tumidicornis*.

In the commonly used keys to species of North American *Chrysops* (Jones and Anthony 1964, Teskey 1969, Tidwell 1973, Pechuman 1973, 1981) *C. tumidicornis* will key to *C. atlanticus*. However, *C. tumidicornis* differs by having a stouter pedicel, frontal callus approximately twice as wide as tall, wing pattern with a distinct hyaline triangle, and an abdominal pattern brown with median orange triangles. *Chrysops tumidicornis* has an extensive apical spot reaching posterior half of 2nd submarginal cell, and a hyaline triangle that does not reach vein R_{2+3} . *Chrysops tumidicornis* appears to be more similar to *C. pudicus* in size, dark mesoscutum and abdominal pattern.

Variation within *C. tumidicornis* ranges from specimens with small, slender body, and a more uniformly dark abdomen, to a larger, more robust body, with an abdominal pattern more uniformly yellow-orange. Three specimens from Gulf County, Florida, have an entirely dark brown abdomen with a lighter median triangle on the 2nd tergite. *Chrysops tumidicornis* is easily recognized by its bulbous, barrel shaped pedicel.

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